

## NOTES ON FOSSIL CROCODILIANS FROM SOUTHEASTERN UNITED STATES <sup>1</sup>

WALTER AUFFENBERG  
*University of Florida*

The Tertiary and Pleistocene strata of southeastern United States are fairly rich in crocodylian remains. For the most part, these fossils have received but little attention in the past. Material examined or collected during the past few years has provided additional information on these animals in this area, and the new data seem worthy of publication.

The paleontological collections of the Florida Geological Survey contain remains of crocodylians from the deposits of Griscom Plantation, Leon County, and Midway, Gadsden County, Florida. These localities are considered Lower Miocene (Wood, *et al.*, 1941). *Alligator olseni* White has been previously reported from only the type locality: Thomas Farm, Gilchrist County, Florida, Lower Miocene. It is thus of interest that the Griscom and Midway deposits also contain remains of an alligatorid crocodylian, here referred to the same species.

From Midway only a few small dorsal plates are available (FGS V-3513, 4186). They are identical to those found at the type locality.

Considerably more material is available from the Griscom Plantation, including several dorsal plates (FGS V-3785a and b, V-1440 and V-1439), some fragmentary vertebrae (FGS V-1437-8 and V-2777) and some badly broken cranial elements. The latter include a lacrimal (FGS V-2768), a broken maxillary (FGS V-1436) and a partial premaxillary (FGS V-1436). None are particularly diagnostic, with the exception of the premaxillary, which is briefly described below.

The element is provided with alveoli for four teeth. The first tooth is missing. The second is represented by a small partial alveolus. Medio-posterior to this is a large pit for the reception of a mandibular tooth. The third and fourth alveoli are large. The fifth is smaller, about the same size as that for the second tooth. Between the large alveoli of the third and fourth teeth, and directly

---

<sup>1</sup> A Contribution from the Biology Department and the Florida State Museum.

behind the first large pit, is a small pit. This is followed by one which is slightly larger, on a level between the fourth and fifth alveoli. A very large pit is present on the premaxillary-maxillary sutural line.

Dorsally a small portion of the narial opening is present. Posterolaterally the opening is bordered by a low rounded ridge.

The distribution and size of the pits and alveoli, as well as the absence of a premaxillary-maxillary notch, indicate that this element probably represents an alligator, rather than a true crocodile. A comparison of this, and the other fragments mentioned above, with the holotype and the other available specimens of *Alligator olseni* from the type locality, shows the closest possible agreement.

The nasal septum in the holotype of *A. olseni* is not entirely preserved. However, White (1942) stated that he believed the septum was complete in this species. There is no doubt of this now, since subsequently specimens collected, maintained in the collections of the Museum of Comparative Zoology, all have the septum completely preserved.

Considerably more important are certain observations on the extinct crocodile, *Gavialosuchus americanus*. Material has been collected from several new localities in Florida. Of particular interest is the discovery of a partial skull from South Carolina.

The generic status of *Gavialosuchus* Toula and Kail, has suffered considerable vacillation through the years. Many workers have preferred to synonymize this genus with *Tomistoma* Müller. The most recent of these is Müller (1927).

Mook (1920, 1924) recognized the genus *Gavialosuchus* mainly on the basis of a subtriangular, rather than a circular internal narial opening. This character exhibits at least some variation in the available skulls of *G. americanus* (Auffenberg, 1954). The shape of the opening is also variable in several modern genera; both ontogenetic and individual variation having been observed. The character thus loses considerable diagnostic value, and it is largely on this basis that Müller objected to the retention of the name as a valid genus.

However, at least one character clearly separates *Tomistoma* from *Gavialosuchus* on the basis of the available material. This concerns the presence or absence of a keel on the plates making up the dorsal armor.

A median keel is present in the middle thoracic dorsal plates of all modern crocodylians, including *Tomistoma*. Almost two hundred plates of *Gavialosuchus americanus* are now available, none of which possess a median keel. Approximately fifty plates have been collected along with a nearly completely articulated skeleton of this form from a deposit near Haile, Alachua County, Florida (Auffenberg, 1954). None of the plates possess any median keels. Several fossil genera are known in which the plates lack this structure. De Vis (1885) has described plates from *Pallimnarchus pollens*, a Pleistocene crocodile from Australia, which are very similar to those found in association with *G. americanus*. However, armor of this type constituted only a small percentage of the total number secured from the same deposit. Forty per cent of the plates of *Pallimnarchus* were distinctly keeled. De Vis thus assumed that the un-keeled members belong to the abdominal series. This may be true; but the total absence of *any* keeled plates in association with *Gavialosuchus americanus* suggests that a keel is lacking in all of the plates in this form.

As far as is known, *Gavialosuchus* is the only crocodylian from southeastern United States in which keeled plates are absent. Until other Tertiary crocodylians are found in this area which also lack these structures, the occurrence of plates of this type in any Tertiary deposit in this area would seem to suggest the presence of this, or some very closely related form.

A small un-keeled fragmental plate, provisionally referred to *G. americanus*, has been found in a small brook flowing over the Hawthorne formation in the western part of the campus of the University of Florida, Gainesville. A similar but larger and better preserved plate (UF 3395) has been collected from the bed of the stream formed by Glen Springs, in the northwestern part of Gainesville, Alachua County, Florida (R20E, T93, Sec. 30). Associated with the piece were teeth of the extinct shark, *Hemipristis*, various rib fragments of a sirenian and a last molar of the extinct dugong, *Felsinotherium*. The deposit is Upper Miocene, Hawthorne formation (Pirkle, 1956).

The fact that UF 3395 originates from an Upper Miocene deposit, and that the type locality of the species, the Bone Valley formation of central Florida, is now considered as representing the same period (Olsen, 1956; Vernon, 1951; etc.), suggests that the completely articulated specimen from Haile, Locality VI, Alachua

County, (Auffenberg, 1954) also represents this period. The genus should definitely be listed among the Miocene vertebrates of Florida, and included the Pliocene fauna only with reservation.

Considerably more important is the discovery of this species of crocodile in South Carolina. The available material consists of a partial skull (ChM 13745) and two dorsal plates (ChM 13942 and 35.208.176) in the Charleston Museum, Charleston, South Carolina.

Number 13942 is part of the old collection of that museum, and the datum is simply "South Carolina Phosphate Beds". Number 35.208.176 was collected at Edisto Beach, Charleston County. Both the phosphate beds and Edisto Beach are known to contain Miocene, Pliocene (?) and Pleistocene vertebrates. The Miocene forms are all marine species. The Pleistocene fauna contains both terrestrial and marine vertebrates. The Pliocene fauna, if present at all, is almost entirely unknown. Both of the plates lack the median keel, and are identical to those collected from various localities in Florida.

The skull was collected during phosphate excavations near Lambs, Charleston County. The surrounding matrix is typical of the phosphate-bearing strata of Charleston County; generally thought to represent the Upper (?) Miocene, although possibly reworked (at least in part) during the Pleistocene.

The skull is crushed from above and slightly from behind. It includes the anterior edge of the right orbit, including the very anterior portion of the quadrato-jugal, the right lacrimal, right pre-frontal, part of the nasals and a fair portion of the maxillary. There are five maxillary teeth on the right side. The right palatal fenestra is present. It is of the same shape as that in the skulls in the American Museum of Natural History Collection (AMNH 1651 and AMNH 5663). It is proportionately longer than in UF 6225; although the latter was somewhat crushed in this general area, so that the slight difference in length may not be significant. There are five teeth on the right side, all of which are almost completely smooth and non-ribbed, as those in the other available skulls of *Gavialosuchus americanus*. A number of alveoli are also present on the same side. The last tooth in UF 6225 is the nineteenth. Assuming the same number of teeth in the Charleston skull, the fragment extends anteriorly to the eleventh alveolus. The larger of the available teeth would thus represent numbers fourteen and fifteen, as in UF 6225. The palatines extend forward for a dis-

tance of three teeth from the palatal fenestra, as in UF 6225 and AMNH 5663.

There is little reason to believe that the Charleston Museum skull represents a form other than *G. americanus*. This specimen thus extends the known range of the species considerably northward of that previously proposed. Miocene marine deposits west of peninsula Florida should yield additional remains of this interesting crocodilian.

Isolated fragmental skull and mandibular teeth, as well as plates of the dorsal armor of *G. americanus* in several collections, indicate that this crocodilian grew to a very large size. Some of the plates exceed eleven centimeters. Assuming these to be the largest of the dorsal series, there is every reason to believe that the species attained lengths in excess of thirty feet.

A single fragmentary maxillary in the collections of the Charleston Museum (ChM 41.188.45; "Phosphate Beds, South Carolina") is very interesting in that it is provided with a single tooth which is strongly ribbed. The tooth is approximately ten millimeters long, and thus considerably smaller than those in the available skulls of *G. americanus*. The shape of the maxillary suggests that of *Gavialosuchus*; i.e.: a long, narrow snouted crocodilian. Strongly ribbed teeth occur only in *Crocodylus cataphractus* among Recent forms, although many fossil forms are known to have possessed them.

Ribbing is somewhat variable, even within the same species (Mook, 1931). It is not, however, a character associated with age, since smaller specimens of *Gavialosuchus americanus* have almost completely smooth teeth, as do the adults. Furthermore, some ribbed teeth available from other areas are as large, if not larger than many of those of *G. americanus*. Newly replaced teeth of *G. americanus* are also smooth.

Ribbed crocodilian teeth occur in the Bone Valley formation of Florida, as for example, in FGS V-4993, a posterior tooth in which plications are found at the base. More important, a number of fossil crocodiles have been described from Tertiary (?) deposits of the central eastern seaboard. Some of these, like *Pliogonodon priscus* Leidy, are provided with ribbed teeth. The relationships of the southeastern crocodiles possessing teeth of this type to species from the central Atlantic states are completely unknown. Until the fossil crocodilians of New Jersey and Maryland are studied in

some detail, it will be impossible to assign the unusual South Carolina and Florida specimens to a particular genus or species.

The skull and dorsal plates of *Holops* Cope, a form known from the Cretaceous and Eocene, are very similar to those in *Gavialosuchus*. The teeth of the two genera are also very close. The relationships of these genera should be investigated. Several of the long-snouted European Tertiary crocodylians, such as *Crocodylus toliapicus*, *C. arduini* and *C. champsoides* should be re-examined in the light of more recent information on *Gavialosuchus*. Other than the characters mentioned above, attention should also be drawn to the shape of the prefronto-frontal suture, which is less angular and more rounded in *Holops*, *Gavialosuchus*, *Crocodylus toliapicus*, *C. arduini* and *C. champsoides* than it is in any other recent or fossil long-snouted crocodylian, with the possible exception of *Crocodylus cataphractus*. *Crocodylus champsoides* may be close to *C. cataphractus*. The similarity in morphology of all of these forms, even though slight, should be examined to determine possible relationships or parallel evolutionary trends.

Although many fossil crocodylians have been described, their relationships to one another are far from being understood. We know almost nothing concerning the ancestry of our Recent crocodylians though phyletic lines culminating in these forms should be at least partially represented in the fossils already available. It has been only relatively recently that serious attention has been drawn to many un-studied collections of Cenozoic reptiles and amphibians. As interest in this field continues to develop, it is hoped that phyletic lines of Recent forms will become established. This need is as great in the study of the crocodylians as it is in the urodeles, salientians and snakes.

#### LITERATURE CITED

AUFFENBERG, W.

1954. Additional specimens of *Gavialosuchus americanus* (Sellards) from a new locality in Florida. *Quart. Journ. Fla. Acad. Sci.*, 17(4): 185-209.

DE VIS, C. W.

1885. On remains of an extinct saurian. *Proc. Roy. Soc. Queensl.*, 2: 181-191.

MOOK, C. C.

1920. Skull characters and affinities of the extinct Florida gavial, *Gavialosuchus americanus* (Sellards). *Bull. Amer. Mus. Nat. Hist.*, 44: 39-46.

1924. Further notes on the skull characters of *Gavialosuchus americanus* (Sellards). *Amer. Mus. Nat. Hist. Nov.*, No. 155, pp. 1-2.
1931. New crocodilian remains from the Hornerstown Marls of New Jersey. *Amer. Mus. Nat. Hist. Nov.*, No. 476. pp. 1-15.
- MULLER, L.
1927. Ergebnisse der Forschungereisen Prof. E. Stromers in dem Wusten Aegyptens. Vol. 5. Tertiare Wirbeltiere. No. 1. Beitrage zur kenntnis der Krokodilien des aegyptischen Tertiars. *Ahb. Akad. Wiss. Munchen. Math.-natur.* 31 : 1-97.
- OLSEN, S. J.
1956. A new species of *Osteoborus* from the Bone Valley Formation of Florida. *Fla. Geol. Sur., Spec. Bull. (2) Contr. to Fla. Vert. Paleon.*, Paper (1) : 1-5.
- PIRKLE, E. C.
1956. The Hawthorne and Alachua formations of Alachua County, Florida. *Quart. Journ. Fla. Acad. Sci.*, 19(4) : 197-240.
- VERNON, R. O.
1951. Geology of Citrus and Levy Counties, Florida. *Bull. Fla. Geol. Surv.*, (33) : 1-186.
- WHITE, T. E.
1952. The Lower Miocene mammal fauna of Florida. *Bull. Mus. Comp. Zool.*, 92(1) : 1-47.
- WOOD, H. E. *ET AL.*
1941. Nomenclature and correlation of the North American continental tertiary. *Bull. Geol. Soc. Amer.*, (52) : 1-48.